

Supplementary Materials: Simplified Design Method for the Mechanical Stability of Slit-Shaped Additive Manufacturing Reactor Modules

David F. Metzger ^{1,*} , Christoph Klahn ²  and Roland Dittmeyer ¹ 

Table S1. Composition of metal powders in wt-%. Both powders conformed both ASTM A276 and DIN EN 10088.

Component	CT 316LF Batch PR100334	POWDERRANGE SLM Solutions 316L Batch 2022000726
C	0.02	0.011
Cr	17.8	16.901
Fe	Bal.	Bal.
Mn	0.91	1.127
Mo	2.34	2.322
Ni	12.6	11.413
N	0.06	0.0987
O	0.02	0.0385
P	0.012	0.012
Si	0.67	0.718
S	0.007	0.02

Table S2. Modules without internal structures $t_w=1\text{ mm}$, $\varphi=0$.


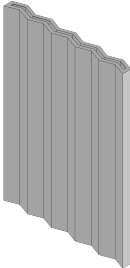
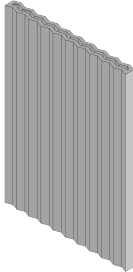
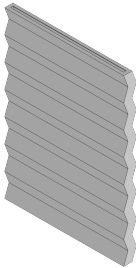
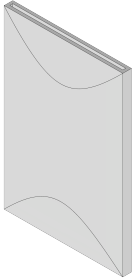
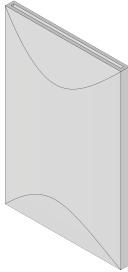
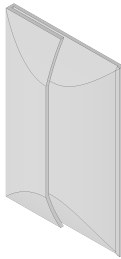
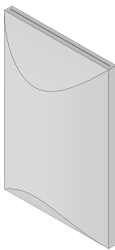
Planar	Corrugated $n = 5$	Corrugated $n = 10$	Corrugated per- pendicular
			
Arched $\delta=5^\circ$	Arched $\delta=15^\circ$	Arched $\delta=30^\circ$	Arched $\delta=45^\circ$
			

Table S3. Pin-equipped modules with $t_w=0.6$ mm.

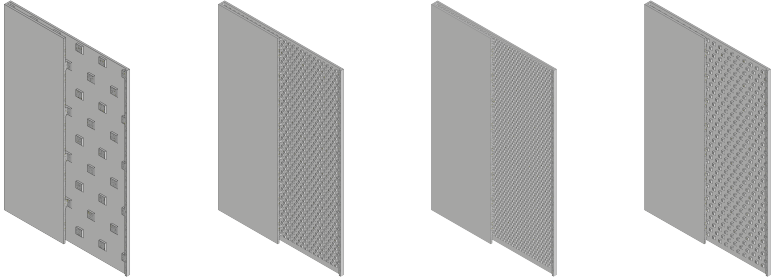
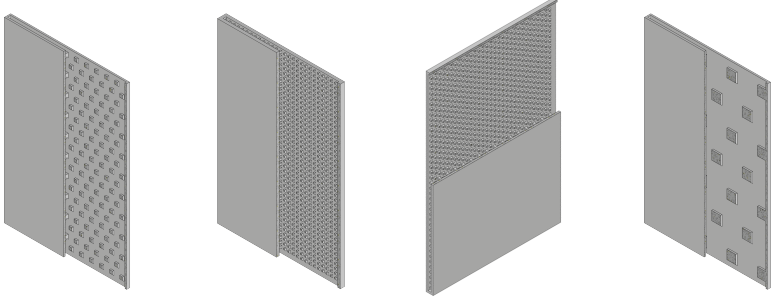
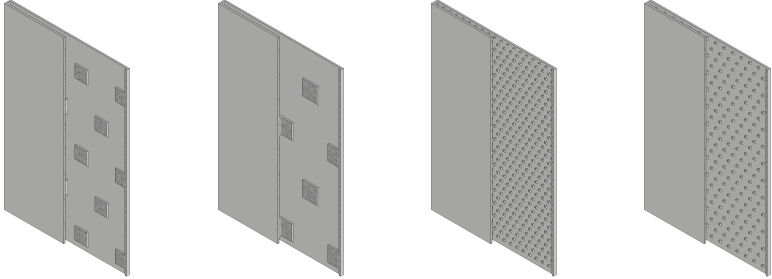
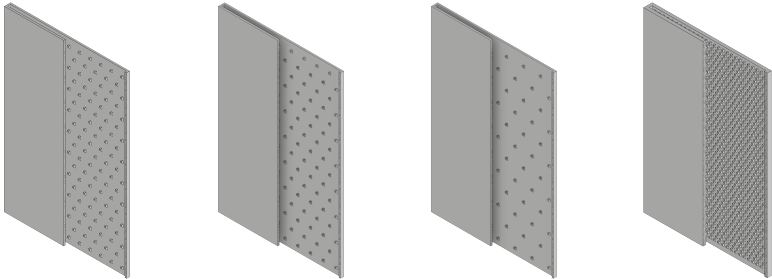
t_p / mm	2	0.42	0.26	0.6
				
φ / -	0.09	0.15	0.19	0.14
t_p / mm	1.0	0.42 regular.	0.42 trans.	3
				
φ / -	0.12	0.13	0.15	0.12
t_p / mm	4	5	0.42	0.42
				
φ / -	0.11	0.11	0.07	0.04
t_p / mm	0.42	0.42	0.42	0.42, $t_w=1$ mm
				
φ / -	0.02	0.017	0.01	0.15

Table S4. Fin-equipped modules.

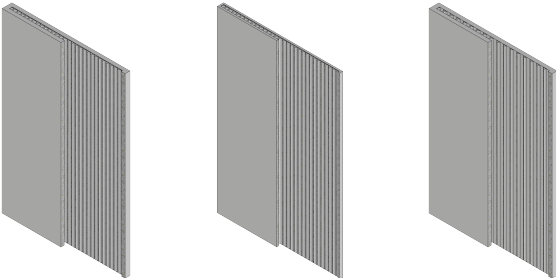
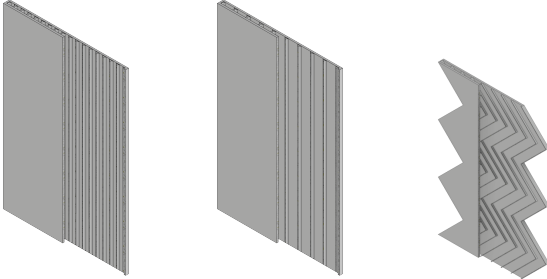
t_w / mm	1.0	0.6	1.0
t_e / mm	1	1	2
			
φ / -	0.33	0.33	0.14
t_e / mm	2	4	4
t_w / mm	0.6		
			
φ / -	0.14	0.10	

Table S5. FGE-equipped modules $t_w=0.8$ mm.

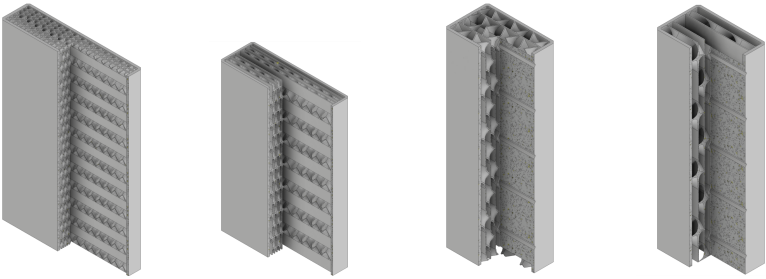
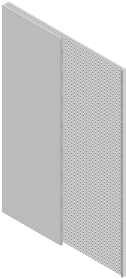
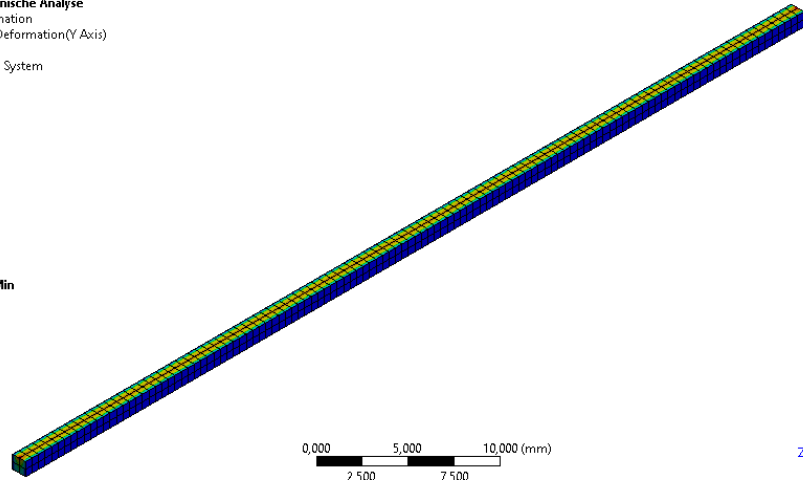
d_{FGE} / mm	1.333	2	3	4
				
φ / -				

Table S6. Lattice-equipped module.

	6201
t_w / mm	0.6
t_e / mm	1
	
φ / -	0.20

I: Statisch-mechanische Analyse
 Directional Deformation
 Type: Directional Deformation(Y Axis)
 Unit: mm
 Global Coordinate System
 Time: 1
 07.03.2024 12:36

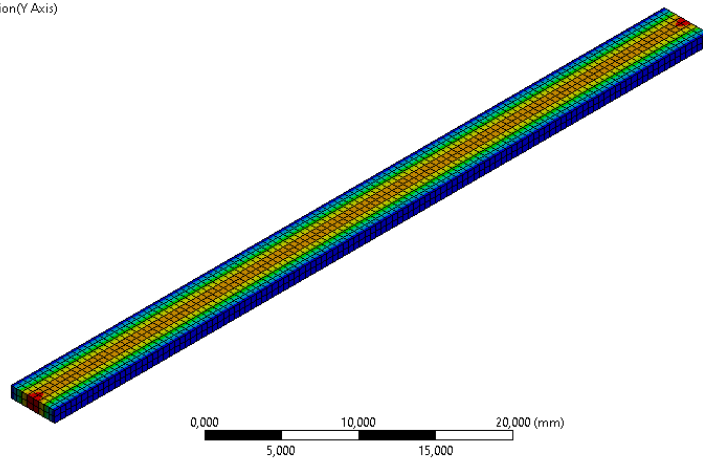
0 Max
 -1,1193e-6
 -2,2386e-6
 -3,358e-6
 -4,4773e-6
 -5,5966e-6
 -6,7159e-6
 -7,8352e-6
 -8,9546e-6
-1,0074e-5 Min



(a) $w=1$ mm.

J: 06_RectD4_01
 Directional Deformation
 Type: Directional Deformation(Y Axis)
 Unit: mm
 Global Coordinate System
 Time: 1
 07.03.2024 13:04

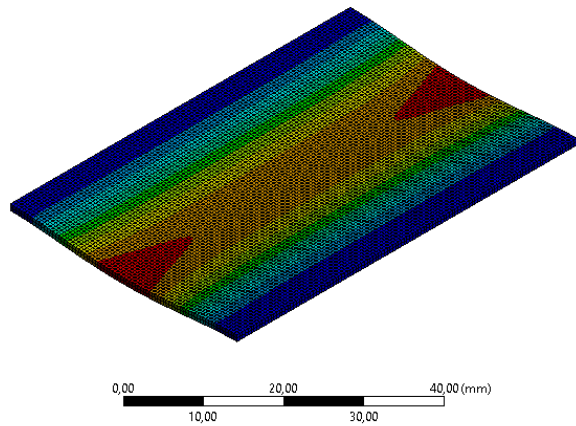
0 Max
 -2,4453e-5
 -4,8906e-5
 -7,3358e-5
 -9,7811e-5
 -0,00012226
 -0,00014672
 -0,00017117
 -0,00019562
-0,00022008 Min



(b) $w=4$ mm.

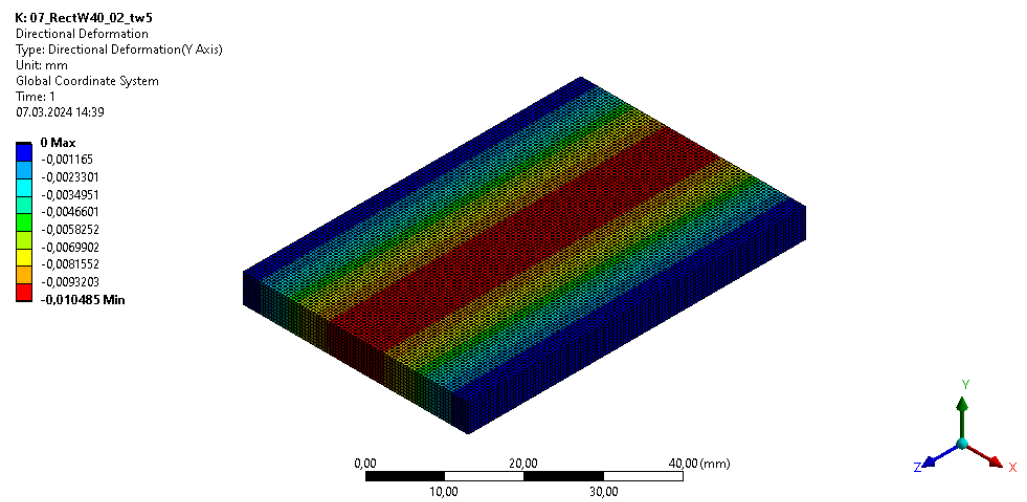
K: 07_RectW40_01
 Directional Deformation
 Type: Directional Deformation(Y Axis)
 Unit: mm
 Global Coordinate System
 Time: 1
 07.03.2024 13:05

0,0008195 Max
 -0,13675
 -0,27432
 -0,41189
 -0,54946
 -0,68703
 -0,8246
 -0,96217
 -1,0997
-1,2373 Min



(c) $w=40$ mm.

Figure S1. FEA results of empty and fin-equipped modules $t_w=1$ mm, $l=60$ mm.



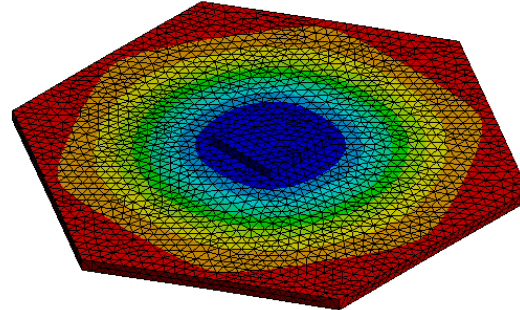
(d) $w=40$ mm, $t_w=5$ mm.

Figure S1. FEA results of empty and fin-equipped modules $t_w=1$ mm, $l=60$ mm. (cont.)

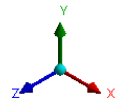
B: 01_BendEdge_01

Verschiebungskomponente
Type: Directional Deformation(Y Axis)
Unit: mm
Globales Koordinatensystem
Time: 1
07.03.2024 11:23

0,00076456 Max
-0,037886
-0,076537
-0,11519
-0,15384
-0,19249
-0,23114
-0,26979
-0,30844
-0,34709 Min



0,000 5,000 10,000 (mm)
2,500 7,500

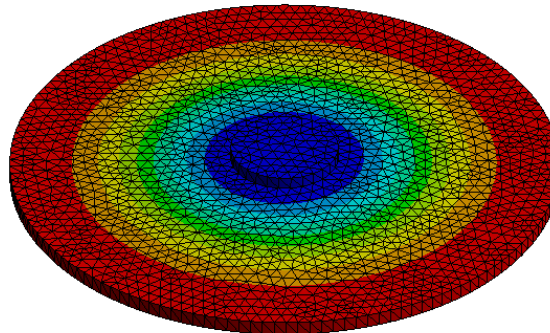


(a) $t_p=4$ mm, $a=20$ mm.

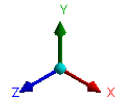
C: Statisch-mechanische Analyse

Directional Deformation
Type: Directional Deformation(Y Axis)
Unit: mm
Global Coordinate System
Time: 1
07.03.2024 11:36

0,00071592 Max
-0,037369
-0,075454
-0,11354
-0,15162
-0,18971
-0,2278
-0,26588
-0,30397
-0,34205 Min



0,000 5,000 10,000 (mm)
2,500 7,500

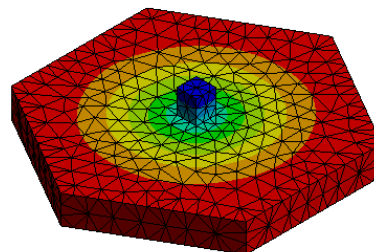


(b) $d_i=4.514$ mm, $d_o=21$ mm.

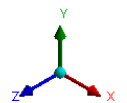
D: 03_Rupture_01

Directional Deformation
Type: Directional Deformation(Y Axis)
Unit: mm
Global Coordinate System
Time: 1
07.03.2024 13:03

0 Max
-0,00033269
-0,00066538
-0,00099807
-0,0013308
-0,0016634
-0,0019961
-0,0023288
-0,0026615
-0,0029942 Min

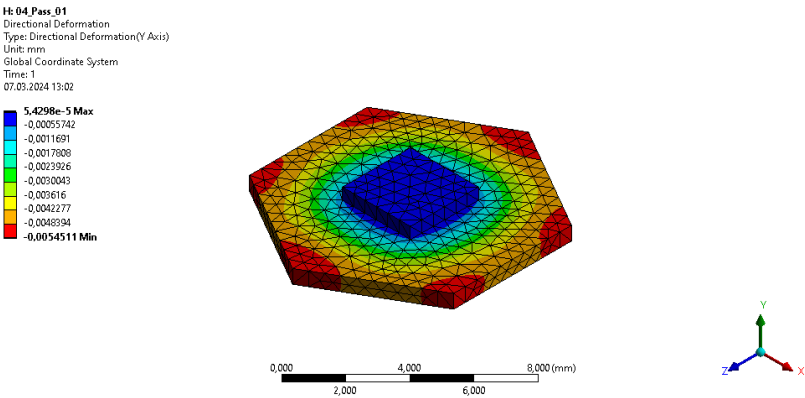


0,000 2,500 5,000 (mm)
1,250 3,750

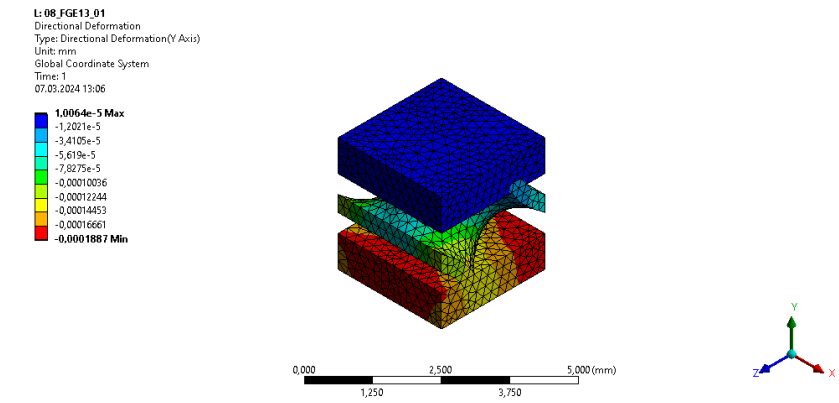


(c) $p=0.42$ mm, $a=5$ mm, $\varphi=0.0081$.

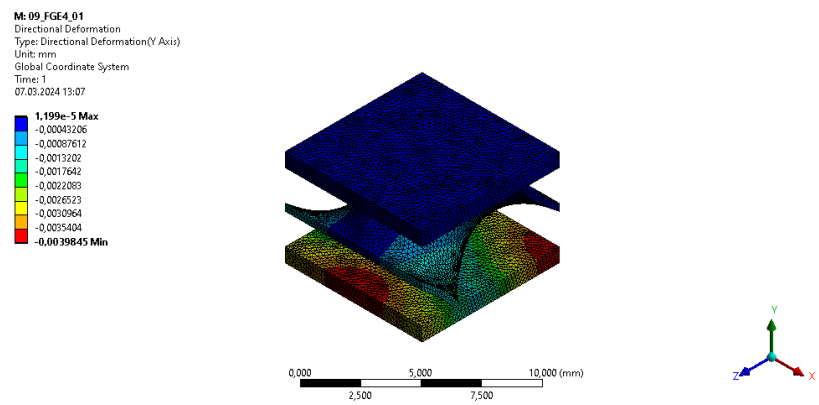
Figure S2. FEA results of pin-equipped modules $t_w=0.6$ mm.



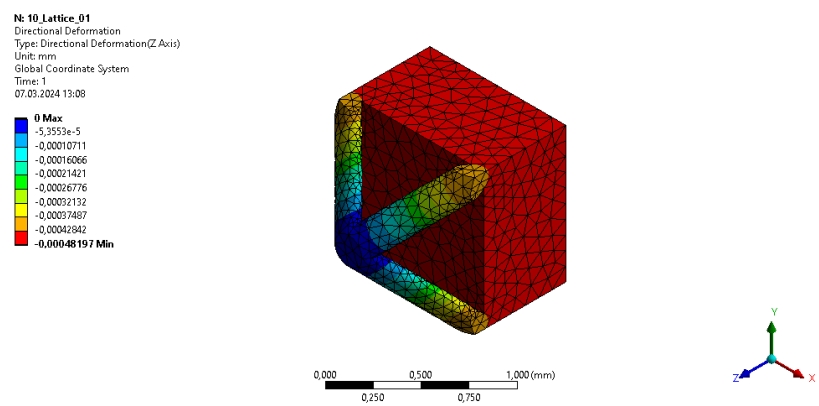
(d) $p=3\text{ mm}$, $a=9\text{ mm}$.
Figure S2. FEA results of pin-equipped modules. (cont.)



(a) $d_{FGE}=1.333$ mm.



(b) $d_{FGE}=4$ mm.



(c) $d_{strut}=0.2$ mm.

Figure S3. FEA results of FGE-equipped ($t_w=0.8$ mm, $t_{FGE}=0.4$ mm) and lattice-equipped ($t_w=0.6$ mm) modules.

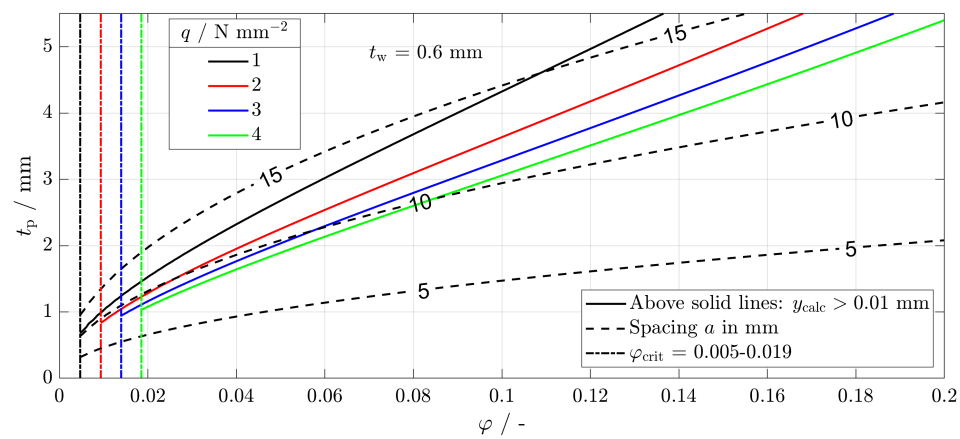


Figure S4. Calculated stability criterion for various loads at constant thickness.

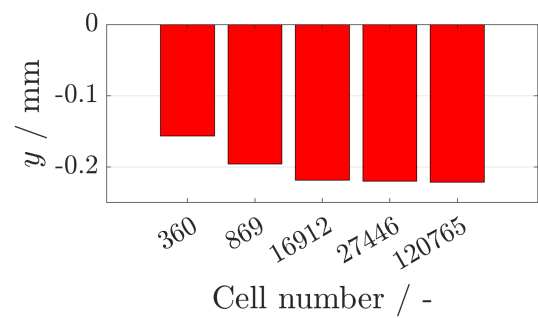


Figure S5. Results of mesh independence study with element size from $t = 2, 1, 0.5, 0.2$, to 0.1 mm.

Author Contributions: Conceptualization, D.F.M., C.K. and R.D.; methodology, D.F.M.; software, D.F.M.; validation, D.F.M.; formal analysis, D.F.M.; investigation, D.F.M.; resources, C.K. and R.D.; data curation, D.F.M.; writing—original draft preparation, D.F.M.; writing—review and editing, D.F.M., C.K. and R.D.; visualization, D.F.M. and C.K.; supervision, C.K. and R.D.; project administration, C.K. and R.D.; funding acquisition, R.D. All authors have read and agreed to the published version of the manuscript

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Data Availability Statement: Data can be made available upon request.

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Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

Symbol	Meaning	Unit
<i>Latin Symbols</i>		
d_{FGE}	Depth of fluid guiding element	mm
d_{strut}	Diameter of strut	mm
t	Dimension	mm
t_{w}	Wall thickness	mm
<i>Greek Symbols</i>		
δ	Angle of inclination of parabola	$^{\circ}$
ϕ	Volume fraction	
<i>Indices</i>		
e	Empty	
l	Lattice	
p	Pins	

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